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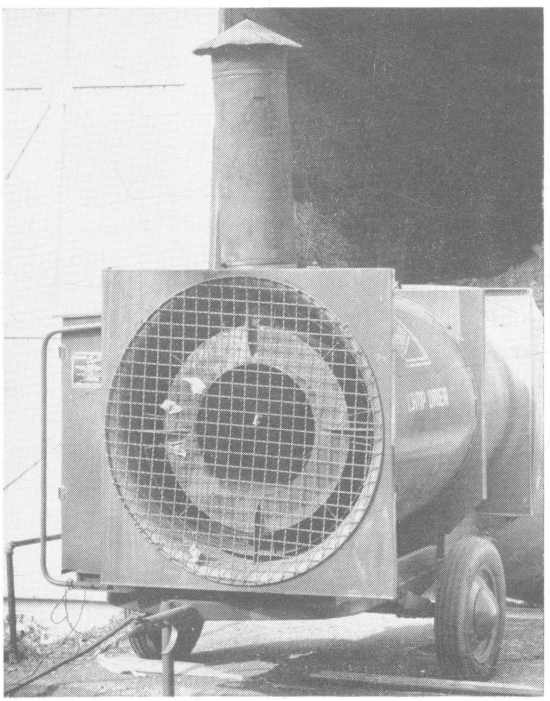
MOW HAY DRIERS--

their use, investment cost and operating expense



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MOW HAY DRYERS—THEIR USE, INVESTMENT COST AND OPERATING EXPENSE

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INTRODUCTION

Harvesting large tonnages of high quality hay is a difficult job on most farms. Hay is an important crop because of its value as a livestock feed. More than a fifth of the cropland in Ohio has been used to produce three and three-fourths million tons of hay annually for the past decade. This crop has a value of more than 75 million dollars to Ohio farmers each year.

Uncertainties of weather during hay harvest have plagued farmers for years. Feeding quality of hay deteriorates rapidly with rain damage, overexposure to sun or delay in harvest resulting in overmaturity. Increased production and harvesting costs are common problems of farmers trying to make high quality hay. Many attempts have been made to improve harvest methods. Generally, a reduction of losses must come from a shortening of the time interval between cutting and storage of the hay. During the 15 years, 1938-1952, Bere found an average of three periods of three or more consecutive good drying days during the month of June.[1] Climatic conditions were such that hay cut on the first day could have been stored on the third day with unaided field curing. During four of the 15 years, only one favorable June hay curing period occurred.

Bere found an average of six periods of two days or more in June favorable for hay curing during these same 15 years. This means that twice as many periods were available for harvesting hay if storage could be completed on the second day rather than the third.

Two harvesting methods now in use help to reduce the interval between cutting and storing hay. These are: (1) field conditioning[2]

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[1]Bere, R. L., "The Effects of Climatological Factors on the Time Available to Do Selected Farming Operations in Central Ohio, 1953." Unpublished Master's Thesis, Ohio State University, 1953.

[2]Moore, C. V., J. H. Sitterley and E. T. Shaudys, "Cost of Hay Conditioning for Faster Field Curing," Ohio Agricultural Experiment Station Research Bulletin 834, Wooster, 1959.

and (2) mow drying. Crushing or crimping the plant stem with a field conditioner permits moisture to escape faster, speeding up the field curing process. Mow drying permits the hay to be taken up before it is dry enough for normal storage. The curing process is completed in the mow by forcing air through the hay to remove enough of the remaining moisture for safe storage. Mow hay drying can be accomplished by either natural or heated forced air. Drying can be done with the hay on wagons, in a small batch mow or in the mow where it will be stored until fed. This study was limited to drying in mows, where the hay will be stored, with natural forced air.

HOW THE STUDY WAS MADE

The benefits of mow drying hay are not without additional costs. This study considers: (1) the costs of installing a mow dryer without air heating facilities and (2) the annual costs of using this equipment to dry hay.

A list of farmers using mow dryers was compiled with the assistance of county agents, equipment dealers and power company representatives. Information on installation, capacity, costs and experience was obtained for 14 dryers located on 12 farms. These farms were located in the southwestern Ohio counties of Butler, Clinton, Greene, Highland and Montgomery. In the attempt to locate farms with mow dryers, three were found with dryers that were no longer in use.

FINDINGS

The 12 farms averaged 223 acres and ranged from 90 to 360 acres. Nine of the 12 farms were owner operated, although 3 of these rented additional acreage. The other three farms were operated by tenants.

After installation of the mow dryer, the 12 farmers field cured about 45 percent of their hay and mow dried 55 percent. In addition to the hay, 8 farmers preserved an average of 90 tons of grass-legume silage each year.

TABLE 1.—Tonnage of Forage Harvested by Method of Preservation, 12 Ohio Farms, 1958

Type	Number of farms	Tons	
		Average	Range
Mow dried hay	12	76	40–165
Field cured hay	12	62	7–120
Silage	8	93	52–150

Generally, the mow dried hay was fed to livestock producing a salable product. Dairy cattle received this high quality feed on 10 farms and beef cattle on 2 farms. Four of the dairy farmers fed all of their mow dried hay to the milking herd. The other 6 farmers fed about three-fourths of the mow dried hay to the milking herd and the remaining one-fourth to replacements and dry stock.

Alfalfa was used in the hay mixture on all except one farm. Six farmers used a meadow mixture of half alfalfa. The other 5 mixtures varied from 25 to 90 percent alfalfa. Timothy or brome grass was used as part of the mixture on all of the farms.

Most of the mow drying equipment had been installed 8 to 12 years ago. Two dryers included had been installed during 1958. All but one of the dryers had been built to be used with chopped hay. However, at present, 4 of the dryers were being used with baled and 10 with chopped hay.

Time of Cutting

The farmers interviewed reported that hay cut to be dried was in a early or pre-bloom stage. Only one farmer indicated that the hay was permitted to mature before cutting.

TABLE 2.—Number of Farms Reporting Maturity of Hay by Cuttings for Mow Drying, 12 Ohio Farms, 1958

Stage of bloom	Cutting		
	First	Second*	Third
Prebloom	5	1	1
One-fourth	7	9	8

*One farmer reported making second cutting at full bloom.

Three cuttings of hay were dried with the same equipment on 9 of the 12 farms. Second and third cuttings were stored on top of the first until the capacity of the mow or the dryer was attained. The farmers cooperating in the study reported that 14 feet was about the depth that could be dried satisfactorily with either baled or chopped hay. The capacity could be comprised of one or more cuttings. Moisture was removed as long as air could be forced through the hay mass.

The time interval between mowing and storing was reduced one or more days on most farms. Hay was usually stored the day after cutting. Under exceptionally good drying conditions, some farmers reported

TABLE 3.—Hours between Cutting and Taking Up Hay for Mow Drying, 12 Ohio Farms, 1958

Year	Hours	
	Median	Range
Best	21	5–28
Typical	22	8–48
Poorest	48	24–72

storing hay the same day it was cut. Ideally, storing hay on the day cut minimizes weather risk but requires a longer period of artificial drying and higher cost. Generally, the farmers using driers felt the added cost of using the dryer for a longer period of time was much greater than the weather risk. Typically, just under one day (22 hours) lapsed between mowing and storing. Rain damaged hay was rarely mow dried. Most farmers would field cure the damaged hay and store it in a conventional mow.

Testing for Moisture

Immediately after storing, the fan was turned on and operated continuously for 2 to 3 days, depending on the moisture content of the hay when stored. After the initial drying period, the fan was operated intermittently until the hay was considered dry enough for safe keeping. Most farmers tested for moisture by feeling for hot spots. This was done by going into the mow after the fan had been stopped for about an hour, permitting the hay to heat. Another person turned on the fan while the man in the mow walked over the hay and felt the air forced through. If hot air were coming from the hay mass, the fan would be operated intermittently until drying was completed. When this test was used and no hot spots could be detected, the hay was considered dry and safe for storage.

On rainy days or when the air had a high moisture content, little drying could be accomplished. The farmers reported operating the fans only to prevent heating during these periods. Drying was most effective when the atmosphere contained little moisture.

Power

A 5 horsepower electric motor was used to power the fan for 8 of the 14 dryers. Three dryers were powered with 7.5 horsepower motors, one dryer had a 10 horsepower and another, a 3 horsepower electric motor. The remaining dryer was powered with an 18 horsepower gasoline engine.

Mow Capacity

An extreme variation was found in the size and capacity of the mows equipped with dryers. The smallest mows studied were 15 feet wide, 30 feet long and were filled 14 feet high. One farmer used 2 mows of this size equipped with separate dryer units. Filled to capacity, a mow of this size holds 25 to 30 tons of chopped hay. The typical mow equipped with a dryer held 80 to 90 tons of hay. A few large mows held up to 120 tons of hay.

TABLE 4.—Size of 14 Mows Equipped with Mow Dryers on 12 Ohio Farms, 1958

Measure	Average	Range
Length	44	30–70
Width	30	15–42
Square feet	1320	450–1800
Height	14	7–19
Cubic feet	18480	6300–29376

The small mow had a higher cost per ton of dryer capacity than average or large mows. Most farmers reported the 80 to 90 ton capacity mows were efficient considering the dryer investment cost per ton and the annual use cost.

Distribution System

Twelve of the 14 dryer systems were constructed with a central main duct. Modifications of this basic dryer design were used to fit individual barn situations.

Lateral small ducts were used on both sides of the main central duct. The lateral ducts were usually 12 to 15 inches wide by 12 inches high and were made in sections 4 to 10 feet long. Some farmers telescoped the lateral duct toward the edges of the mow. Strong construction is used for lateral ducts as they must support considerable

TABLE 5.—Size of Main Ducts of 14 Mow Dryers, Ohio, 1958

Measure	Size in feet	
	Typical	Range
Length	30	20–50
Height	5	4–6
Width	4	3–5

weight when the mow is filled. The ducts rest on 2 by 4 inch cleats nailed across the bottom. This facilitated the movement of air from the duct system through the hay in the mow.

Two farmers were using a main side duct. These systems had the large main duct built along one side of the mow with all of the distribution laterals on one side.

The main ducts were of heavy framework construction covered with a variety of materials. Ten of the 14 main ducts were sheeted with tight tongue and grooved flooring. The other 4 had the frame enclosed with plywood, insulation board, used lumber or a heavy wire mesh.

Air tight mains were required in systems used before the mow was completely filled. An even distribution of air through the entire hay mass is essential. If a large part of the air escaped from the main with little going through the lateral, some areas of the mow would be dry before other areas were dry enough for storage. Mows filled so the main duct was covered sufficiently to permit uniform air distribution did not have to be of air tight construction.

Some of the mows required tightening of the floors and re-enforcing of the supporting structures. Mow floors were made tight enough to minimize downward air losses. Tongue and grooved flooring was used for most of the mow floors. Other floors were made tight with felt paper. The costs of the materials and labor were in addition to the dryer investment.

INSTALLATION OR INVESTMENT COSTS

The fan and motor were the largest items of installation cost. Two types of fans were found in use, multiblade propeller and drum or squirrel cage. Three size propeller type fans were in use: five, 36 inch; five, 42 inch; and three, 48 inch. One centrifugal or drum type fan was very satisfactory but had a much higher original cost (total installation cost, $1350).

TABLE 6.—Cost of Installing 13 Mow Dryers on 11 Ohio Farms, 1958*
(Propeller Type Fans)

Item	Cost	
	Median	Range
Fan and motor	$520	$250–1000
Ducts	104	25– 300
Wiring	120	10– 250
Labor	50	30– 250
Total	$794	$315–1800

*Adjusted to 1958 prices.

Size of fan and motor and the amount of repair or remodeling of the barn were responsible for considerable variation in investment costs.

The average cost of the mow dryer installation, including the fan, motor and necessary electric wiring was $794. Cost of the 42 inch fan installations averaged $855 and 36 inch fan installations, $707.

ANNUAL USE COSTS

The annual drying cost varies with the tonnage dried and the capacity of the equipment. Typically, 42 inch fans were used to dry 80 tons of hay and 36 inch fans, 50 tons each year. Costs averaged $1.94 per ton when 80 tons were dried compared to $2.44 per ton when 50 tons were dried. The total cost of drying 80 tons with a dryer equipped with a 42 inch fan was $155.48 each year. Of this total cost, $89.33 was of a fixed or investment nature and had to be paid for regardless of the quantity of hay dried. Used at capacity of 80 tons, the cost per ton was $1.11 but this cost would be higher for smaller tonnages.

Operating or cash costs vary with the tonnage of hay dried. Repairs averaged 11 cents and electricity 72 cents per ton for the 80 ton dryer used at capacity.

Both the investment, or fixed, and the operating costs were higher per ton for the smaller 50 ton capacity dryer. For 50 tons, the fixed cost would be $1.48 per ton. If a smaller tonnage were dried, the cost of $73.86 would have to be carried by the hay processed. Variable costs of 94 cents per ton were higher than for the larger unit. Thus, there is a cost advantage with the larger dryer of 48 cents per ton.

TABLE 7.—Annual Costs of Owning and Using Two Sizes of Mow Dryers, Ohio, 1958

Item	80 tons of hay (42 inch fan)		50 tons of hay (36 inch fan)	
	Total	per ton	Total	per ton
Investment installed	$855	$10.69	$707	$14.14
Depreciation (15 years)	57.00	.71	47.13	.94
Tax (40% new cost @ 24 mills)	8.21	.10	6.79	.14
Interest (5% of midvalue)	21.38	.27	17.68	.35
Insurance ($4.00 per M on 80% of new cost)	2.74	.03	2.26	.05
Total fixed costs	$ 89.33	$ 1.11	$ 73.86	$ 1.48
Repairs (1% new cost)	$ 8.55	$ .11	$ 7.07	$ .14
Electricity (2.5¢ per KWH)	57.60	.71	40.00	.80
Total operating costs	$ 66.15	.82	$ 47.07	$ .94
Total all costs	$155.48	$ 1.93	$120.93	$ 2.42

CONCLUSIONS

- Ten of the 12 farmers reported using mow drying equipment fed dairy cattle. On six of the 10 dairy operations, replacements received a small proportion of the high quality dried hay. This high quality mow dried hay was primarily fed to high producing milk cows.

- All of the farmers were satisfied with the performance of their mow dryers. Better quality hay was cited by most farmers.

- The added cost of mow drying hay over field curing was $1.94 per ton for 42 inch fans and $2.42 per ton for 36 inch fans when used to 80 and 50 tons capacity respectively.

- The additional costs of mow drying must be offset by the reduction in quality or quantity losses. The period of time between cutting and storing hay (the time hay is subjected to severe weather damage) was reduced at least one day.

- Universally, rain damaged hay was field cured and stored in mows that were not equipped with a dryer.

- Most of the hay was chopped. All of the dryer installations except one were designed and built for chopped hay; however, 4 of the 14 dryers were presently used for baled hay. As long as air could be forced through hay, whether baled or chopped, the hay could be dried.

- Farmers reported that the inflexibility of their mow dryer was a disadvantage. Money invested in a mow dryer can only be recovered by the returns from top quality hay fed to productive livestock.

- Two of the men reported that if they had it to do over they would buy a field conditioner in preference to the mow dryer.